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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/292,186

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DANIEL M. KINZER

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12/03/2002

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EXAMINER

HU, SHOUXIANG

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 12/03/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/292,186

Applicant(s)

KINZER, DANIEL M.

Examiner

Shouxiang Hu

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 01 September 0902.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-6,8-13 and 20-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1,3-6,8-13 and 20-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 15 August 2000 is: a) ☒ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3-6, 8-13 and 20-22 are rejected under 35 U.S.C. 103(a) as being obvious over Floyd et al. ("Floyd"; 6,090,716).

Floyd disclose a trench-type power MOSFET device (Figs. 1 and 10), each of the trench-type MOSFET comprising: a vertical invertible channel composed of a first conductivity type (52) between a heavily doped source region of a second conductivity type (50) and a heavily doped drain region of the second conductivity type (54); gate oxide wall (56), a polysilicon trench gates of the second conductivity type (58A), a source contact (66) in contact with the source region, wherein the layer of the channel material is an epitaxial layer and has a constant concentration along its full length (see Fig. 11).

In the embodiment of Fig. 1 in Floyd, the MOSFET device is an n-channel MOSFET with an n-p-n polarity type, with the first conductivity type being a p type and the second conductivity type being an n type. Although Floyd does not expressly disclose that the MOSFET device can also be a p-channel MOSFET with a p-n-p polarity type, it is well known in the art that a MOSFET design which works under one polarity type is normally also workable under the reversed polarity, as evidenced in the prior art such as

Floyd et al. (6,069,043; see Figs. 3 and 11) and Darwish et al. (5,674,766; see col. 11, lines 20-22).

Therefore, it would have been well within the ordinary skilled in the art at the time the invention was made to make the MOSFET device of Floyd with the polarity being reversed, so that desired channel type and device polarity and improved design flexibility would be achieved.

Regarding claim 3, it is noted that Si is the most widely used semiconductor material.

Regarding claims 4 and 5, the MOSFET device of Floyd with reversed polarity can inherently have a reduced on-resistance and be bidirectional, as it is basically identical to the claimed structure.

Regarding claims 8, 11-13, although Floyd does not expressly disclose that the channel layer can have a resistivity of about 0.17 Ohm-cm and a thickness of about 2.5 μm , and that the substrate has a resistivity less than 0.0005 Ohm-cm, it noted that these values are respectively well within the commonly recognized ranges for the relevant parameters, and that it is old and well known in the art the threshold voltage and the on-resistance of MOSFET are directly correlated to the doping concentrations of the channel layer and the substrate layer; and they are the well recognized parameters of importance subject to routine experimentation and optimization.

Therefore, it would have been obvious to one of ordinary skilled in the art at the time the invention was made to make the MOSFET device of Floyd with the channel layer having a resistivity of about 0.17 Ohm-cm and a thickness of about 2.5 μm and the

substrate having a resistivity less than 0.0005 Ohm-cm, so that the desired threshold voltage and the on-resistance of the MOSFET would be achieved.

Regarding claims 6 and 20-21, it is noted that it is well known in the art that it is desirable to have a source electrode in direct contact with both of the heavily doped source region and the channel-forming base region through a heavily doped base region for improving the device stability, as evidenced in the prior art, such as in Fig. 12 of Floyd et al. (6,069,043) and in Figs. 1,2 and 4 of Darwish et al. (5,674,766).

Response to Arguments

2. Applicant's arguments in the Amendment and the Declaration filed on 9/09/02 have been fully considered but they are not persuasive.

Applicant's main arguments include: (A) applicant disagrees with the examiner's statement that a MOSFET design which works under one polarity type is normally also workable under the reversed polarity, since an artisan of ordinary skill would expect that such reversion would cause a higher on-resistance; (B) there are differences in manufacture and operation between the prior art and the claimed invention; (C) there is a great process difficulty in making the claimed P-channel device; (D) there a tremendous commercial success with the claimed invention; (E) the termination structure is not shown in Floyd; and (F) the instant invention uses boron doping for the gate while Floyd uses phosphorus for that.

In response to applicant's argument A above, it is noted that one of ordinary skill in the art would readily recognize that a MOSFET design which works under one

polarity type is normally also workable under the reversed polarity, as evidenced in Floyd et al. (6,069,043; see Figs. 3 and 11, in which the devices are a direct reversion in polarity of each other) and Darwish et al. (5,674,766; see col. 11, lines 20-22, which shows the reversion is normally expected to be workable in principle); that both n-channel and p-channel MOSFETs are commonly required in many applications, regardless whether the holes in the p-channel device needs to be maximized; and that the simplest reversion in polarity is to simply switch the types of the first and second conductivity types of impurities, as evidenced in Figs. 3 and 11 of Floyd et al. (6,069,043). And, it is also noted that one of ordinary skill would make the p-channel device through the polarity reversion for various region, such as circuit requirement and blocking capability, not just for on-resistance. And, it is well within the ordinary skill in the art to simply reverse the polarity of the n-channel design of Floyd in order to obtained a desired p-channel device, which would result in the claimed invention.

Regarding arguments B and C, any potential implications of process limitations and operation limitations of the claimed invention would not carry patentable weight in the claims drawing to a structure, because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985).

Regarding argument D, it is noted that when evidence of commercial success is submitted, examiners must evaluate it to determine whether there is objective evidence of success, and whether the success can be attributed to the ornamental design. *Litton System, Inc. v. Whirlpool Corp.*, 728 F.2d 1423, 221 USPQ 97 (Fed. Cir. 1984); *In re Nalbandian*, 661 F.2d 1214, 211 USPQ 782 (CCPA 1981). An affidavit or declaration

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under 37 CFR 1.132 has minimal evidentiary value on the issue of commercial success if there is no nexus or connection between the sales of the article in which the design is embodied and the ornamental features of the design. *Avia Group Int'l Inc. v. L.A. Gear*, 853 F.2d 1557, 7 USPQ2d 1548 (Fed. Cir. 1988). In this case, the claimed structure is considered to be obvious as discussed above, regardless how difficult the process could be when making the claimed structure. And, if there is a valid commercial success, it should be the relevant process invention, not the claimed structure, that should be considered to carry patentable weight in view of the commercial success.

With respect to arguments E and F, the features upon which applicant relies (such as the terminal structure and boron doping) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is (703) 306-5729. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers

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for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



SH
November 30, 2002